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FUEL OIL *for* DIESEL LOCOMOTIVES

In Relation to the Supply of Petroleum...

FUEL OIL
for
DIESEL LOCOMOTIVES

A REPORT

By Electro-Motive Division
and Research Laboratories Division
of General Motors Corporation

FOREWORD

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FOREWORD

THE outlook for future petroleum supplies is a matter of great importance because our vital transportation industries are dependent to a large extent upon some form of oil for power. Even though year after year new discoveries of petroleum have more than equaled the ever-growing demand, recent temporary local shortages of petroleum, particularly heating oils, have caused an increasing amount of public concern.

Our nation has become so dependent upon the Diesel locomotive because of its superior performance and its high operating economy that attention has been focused on the increasing use of Diesel fuels by the railroads. To evaluate the railroad liquid fuel requirements and to appraise the outlook for their continued future supply, it is essential to consider the amount of fuel used by the railroads in relation to the quantities used by other important consumers.

From analysis of the facts as presented in the following pages, I am confident that American industry has the resources and the ability to meet the growing fuel demands of our transportation industries, including the railroads, for a great many years to come.

C. F. Kettering

THE SHORTAGE of petroleum products, brought about by an unprecedented post-war demand, has naturally caused concern about the future supply of liquid fuels to serve the domestic needs of our country and to provide for the national defense in time of war. Difficulties in obtaining sufficient fuel oil for home heating in certain parts of the country aroused protests from many local, state, and federal officials and agencies. The publicity which was given to these protests singled out the Diesel locomotive as one of the principal offenders in causing fuel shortage. In fact, certain elements have contended that the expanding use of Diesel power by the railroads has placed a heavy burden upon the refining capacity of the country and has further accelerated the drain upon our diminishing oil reserves. *These contentions are so misleading* that it is imperative for the guidance of national policy to bring out forcibly the true facts of the situation.

*Consumption of Petroleum Products by the Railroads**

In 1947, the total consumption of petroleum products in all fields of use was about 5½ million barrels per day. Of this total, *the railroads, according to Interstate Commerce Commission reports, absorbed some 317 thousand barrels per day or 6% as follows:*

*Class I railroads including switching and terminal companies.

Heavy fuel for oil-burning steam locomotives	265,000 bbls per day
Diesel fuel for all Diesel-Electric locomotives	52,000 bbls per day
TOTAL	317,000 bbls per day

For the 265,000 barrels of heavy fuel, the oil-burning steam locomotives performed about 18% of the work done by the American railroads. The Diesel fuel consumed by Diesel-Electric locomotives in 1947 was 1% of the total consumption of all petroleum products. For these 52,000 barrels of Diesel fuel per day, the Diesel-Electric locomotives performed about 19% of the work done. The balance of the work, some 63%, was performed by coal-burning steam locomotives and electric locomotives using central station power, much of it coal generated.

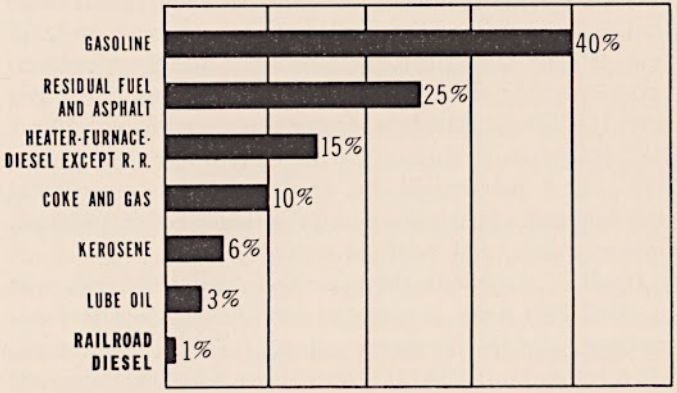
If all of the work done on the American railroads in 1947 had been performed by Diesel-Electric locomotives, the total consumption of Diesel fuel would have been about 256,000 barrels per day. This amount is less than 5% of the total consumption of petroleum products in all fields in 1947, *and is less than the quantity of heavy fuel consumed by the oil-burning steam locomotives in 1947.*

Consumption of Petroleum Products in Other Fields

According to the reports of the Bureau of Mines and American Petroleum Institute, automobiles, trucks, buses, farm tractors, and airplanes which con-

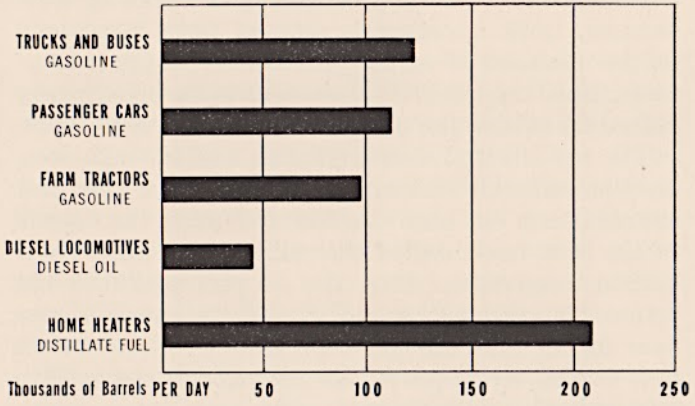
sumed approximately 2 million barrels of gasoline per day in 1947, collectively are the principal users of petroleum products. Users of residual fuels and asphalt consumed about 1,550,000 barrels daily. The oil home heating equipment took about another 580,000 barrels per day. Altogether, the 1947 liquid fuel consumption was divided as shown in the table following:

Division of Liquid Fuel Consumption in 1947



Much of the misunderstanding concerning the overall fuel situation has come about from the argument that Diesel-Electric locomotives consumed 633% more fuel in 1947 than in 1941. Yet this 633% represents an increase of from 7,100 barrels per day to 52,000 barrels daily or a net increase of 44,900 barrels per day. Meanwhile over the same period, the increased consumption by other users of liquid fuel was as follows:

Increase in Petroleum Products Consumption 1941-1947



The increased consumption of petroleum products between 1941 and 1947 by all users other than railroads totals 986,000 barrels per day. The 44,900 barrels daily increase in Diesel fuel consumption by American railroads is by comparison but a drop in the bucket.

The Case for the Diesel Locomotive

The railroads of our country are recognized as an indispensable facility for the well being of industry, agriculture, and communication without which present standards of living would be impossible. They are also a vital necessity for the national defense in time of war. To say that the railroad industry should continue to supply such facilities without an adequate financial return is to expect the impossible.

Yet the railroads are confronted with a rigid income and expense structure. They cannot offset rising costs of material and labor by increasing the price of their services, until approval is secured from regulatory bodies because of strict government regulation of rates. Such approvals, if granted, have customarily lagged far behind the conditions which required them.

The net effect of these rigidities, and other factors, on the railroads' financial structure over the past twenty years has been disastrous. During the decade of the 30's, one-third of the railroads were insolvent and in receivership. Over the 20 year period, a net return on invested capital of slightly over 3% per year for all railroads has been insufficient to attract new capital for improved services and the extensive modernization of facilities.

Until the Diesel locomotive arrived on the scene in 1936, the railroads appeared powerless to accomplish the rehabilitation of their properties and the reorganization of their finances within the limitations imposed by government control of income and union control of wages. Predictions were rife that the railroads of America were headed for outright government ownership. Today, the picture is quite different.

So effective have Diesel locomotives been in reducing operating costs and improving services *that they have literally paid for themselves out of direct savings over steam operation* while at the same time they have built increased traffic and revenue for the railroads. The Zephyrs, Rockets, Streamliners, Chiefs, and a host of other Diesel powered passenger trains have

converted many losing services into highly profitable ones. Schedules from Chicago to the Pacific Coast have been reduced from 53¾ hours to 39¾ hours by the use of Diesel power.

In switching service, Diesel locomotives during the year 1947 performed over 32% of the switching work done at savings up to 40% per annum on their first cost. In mainline freight service since 1940, Diesel locomotives have taken over the heaviest and fastest freight movements with savings up to 25% per annum on their first cost. Ofttimes, because of higher speeds, the ability to haul longer trains, and greater availability, one Diesel locomotive will replace between four and six steam locomotives.

The two principal ways by which Diesel locomotives effect direct economies over steam are in fuel consumption and in repair costs. In 1947, according to the Interstate Commerce Commission reports, the total fuel bill for steam locomotives was approximately $582,000,000 for coal and fuel oil combined. Had the work performed by these steam locomotives been handled by Diesel locomotives at the same cost recorded by Diesels then in operation, this fuel bill would have been more than cut in half with savings of $340,000,000.

During the year 1947, the railroads spent $527,000,000 on the repair of steam locomotives. Based on the maintenance and repair costs of Diesels then in service, 40% of this amount, or $210,000,000 could be transferred from operating expense to earnings by complete Dieselization. The combined savings in fuel

and repair costs for the year 1947 would have totalled $550,000,000. Such a contribution to earnings is sufficient to increase the average return on total railroad investment from 3% to 5% and would do much to encourage continued investment in better railroad plant and facilities with which to provide improved transportation services at the most economical cost.

Not only does the Diesel locomotive provide means for substantial improvement in railroad service and financial structure as outlined above, but it is the most efficient and economical way to transform liquid fuel into useful work. Diesel locomotives haul goods with five times the fuel efficiency of steam locomotives. When hauled by Diesel locomotives a loaded freight car weighing 40 tons, or more than 20 times the weight of the modern automobile, travels 16 miles per gallon of Diesel oil at an average speed of 22 miles per hour. Thus in the whole vital overland transportation service real conservation of our petroleum resources would be accomplished. By contrast, home heaters obtain practically the same heating efficiency with coal as with oil. Thus the substitution of oil for coal in home heating reduces the liquid fuel reserves without any offsetting gain in efficiency.

What About the Future?

We, who have pioneered the manufacture of Diesel locomotives for the American railroads, are just as interested in the future of the liquid fuel situation as anyone in government, industry, or the general public. The deficiency in supply of petroleum products is just as real as that in steel, meat, or newsprint under conditions of abnormal usage. We earnestly support any proposals for the relief of this condition and for the conservation of our petroleum reserves which are for the greatest good of the greatest number of our people.

Specifically, in order to obtain an increase in the supply of liquid fuel, the oil industry must expand its refinery capacity with modern equipment capable of getting the most fuel possible out of a barrel of crude oil. This need has been recognized by the oil industry and *additional refining capacity is being provided* just as fast as equipment can be procured, requiring an investment running into the billions of dollars. Therefore, there is great risk in formulating any long-term transportation policies based upon conditions which we have every right to believe will be of short duration.

The consumption of gasoline by automobiles, trucks, buses, and airplanes in 1947 has doubled since 1930. Not only have the number of vehicles increased, but in the case of automobiles the consumption of gasoline per car per year has increased from about 500 gallons to about 700 gallons. This is due to increased annual mileage and to the increased average age of cars in use.

If the miles per gallon of existing cars and trucks could be increased by just one mile per gallon, the saving in gasoline consumption would amount to about 150,000 barrels per day. Slower driving speeds alone would provide this much economy. Diversion of 150,000 barrels per day of cracking stock to produce Diesel fuel would provide three times the total 1947 railroad requirements.

But an attack on the fuel economy problem, more fundamental than reduced speed, is needed. General Motors has long been working on the development of high compression engines to use high octane gasoline. These developments have progressed to the point where engines capable of 40% fuel savings will ultimately become available. The problem of manufacturing sufficient quantities of high octane gasoline and the problem of distribution are of such magnitude that progressive steps must be taken to reach this ultimate goal. Test automobiles with engines producing an immediate fuel saving of 20% have been in operation for hundreds of thousands of miles. While it is recognized that the fuel savings on a national basis will be directly proportional to the number of automobiles placed in service with engines of this advanced design, nevertheless, the potential savings aggregate 400,000 barrels of gasoline per day, which is equivalent to eight times the amount of Diesel fuel consumed in 1947 by the American railroads.

The living habits of our people and the economy of our country are permanently geared to the use of automobiles and trucks. Progress can and will be made in improving efficiency and reducing consumption in this field through technological developments in both the automotive and petroleum industries. However, it must be admitted that the eventual exhaustion of our oil reserves when and if it occurs will be due in large measure to fuel usage by these machines. In anticipation of this eventuality, it must be expected as a matter of national necessity that

effective means will be developed over the next 25 years to produce synthetic liquid fuels economically. When this is done, it is not too much to expect that the small additional capacity required to supply Diesel fuel for railroad consumption will also be provided.

Conclusion

It has been stated by some leaders in both government and industry that the shortage of liquid fuels and the huge availability of coal warrant the adoption of a transportation policy favoring the continued use of coal-burning steam locomotives by our railroads instead of Diesel-Electric ones. Emphasis is laid upon the vulnerable position of the nation at war, our limited oil-refining capacity, and the tremendous drain upon our limited oil reserves, through the years from progressive Dieselization of railroad services.

It has been shown that this national policy, if adopted, would actually increase the use of liquid fuel unless both oil-burning steam and Diesel locomotives now in use were disposed of and the entire railroad operation conducted by coal-burning steam locomotives. If such a backward step were seriously contemplated, a review should be made of the transportation problems during World War II and how they were solved. Diesel freight locomotives, because of higher speeds, the ability to move heavier tonnages, and their greater availability for work, handled as much war freight on the trunk lines west of Chicago as could have been handled by an additional newly built railroad from Chicago to the Pacific Coast using steam power alone. So effective was the war work

performed by the Diesel freight locomotive that its manufacture commanded the highest priority on steel and production was continued at capacity throughout the war in spite of the acute shortage of both manpower and material.

For many years, it has been estimated that our proven oil reserves would be depleted in 12 years. While the use of petroleum products is at an all-time high, the discovery of new fields has more than kept pace with current demands so that proven reserves have been steadily increasing. If all the Diesel-Electric locomotives in operation on the American railroads today were to be scrapped tomorrow, *this 12 year reserve would be extended less than 45 days.* Assuming 100% railroad Dieselization as of today, the oil reserves, as was shown earlier in this report, actually would last many months longer.

Certainly, the demonstrated need of our country for an efficient transportation system, and the requirements of our railroads for sufficient earnings to keep them sound and healthy warrant the use by our railroads of the most modern cost-saving tools and equipment which exist or can be developed. That the Diesel-Electric locomotive is so regarded may best be shown by the fact that railroads which own the most productive coal mines for the supply of their coal-burning steam locomotives are among the leaders in the rate of replacement of their steam locomotives with Diesel power.

To insist that the railroads invest their money in coal-fired steam locomotives which were recognized as

obsolete 10 years ago in the light of the foregoing conditions, is like asking the automobile companies, because of the shortage of steel and fuel to return to the manufacture of carriages and wagons. That cannot happen and will not happen, nor will it happen to the railroad industry, regardless of the temporary pressures which may be brought to bear upon it.

September 25, 1948